



34.

BÖLÜM

SANAL GERÇEKLİĞİN REHABİLİTASYONDA KULLANIMI

Ahmet Kıvanç MENEKŞEOĞLU¹

GİRİŞ

Sanal gerçeklik (SG); donanımsal ürünler ve yazılım içeren, gerçek dünyadaki olay ve nesnelere benzer ortamları sunmak için kullanıcıların eş zamanlı etkileşim içinde bulunabileceği simülasyonların kullanımı şeklinde tanımlanmaktadır. Video, televizyon gibi ürünlerden ortamla gerçek zamanlı etkileşime girebilme ve ortamda bulunma hissi ile ayrılmaktadır (1).

SG uygulamaları ana olarak iki farklı kategoride ele alınabilir. SG sistemlerinin kullanıcıyı kapsamına göre 'immersive' (kapsayıcı) ve 'non-immersive' (kapsayıcı olmayan) olarak sınıflandırmak mümkündür. SG sisteminin kapsayıcılık derecesi etkileşimin düzeyine ve sistemin sanal ortam dışındaki uyarılardan kullanıcıyı izole edebilme derecesine bağlıdır (2). Kapsayıcı SG sistemlerinde, kullanıcının etrafını görmesine müsaade etmeyen başa takılan ekranlar kullanılırken, kapsayıcı olmayan sanal gerçeklik sistemlerinde kullanıcının etrafını görmesi mümkündür ve bu sistemlerde bilgisayar ekranı veya televizyon ekranı gibi sistemler kullanılır (Resim-1).



Resim-1: Kapsayıcı ve kapsayıcı olmayan sistemlere örnekler

¹ Arş. Gör., İstanbul Üniversitesi İstanbul Tıp Fakültesi Fiziksel Tıp ve Rehabilitasyon AD, kivanemenekseoglu@gmail.com

SONUÇ

Yukarıda da özetlendiği üzere SG aracılı rehabilitasyon uygulamalarının SP tanılı hastaların rehabilitasyonunda etkin olduğunu belirten birçok kanıt bulunmaktadır. SG temelli uygulamaların yaygınlaşması ve uygun hasta grubunda kullanılması rehabilitasyon başarısını artıracaktır. Bu alanda yapılacak yeni çalışmalarla hastalığa özgü oluşturulacak yazılım sistemlerinin artırılması ve tedavi başarısının hasta istekleri de gözetilerek en yüksek düzeye çıkarılması hedeflenmelidir.

KAYNAKLAR

1. Laver KE, Lange B, George S, Deutsch JE, Saposnik G, Crotty M. Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev*. 2017;11:Cd008349.
2. Baus O, Bouchard S. Moving from virtual reality exposure-based therapy to augmented reality exposure-based therapy: a review. *Front Hum Neurosci*. 2014;8:112.
3. Perez C, Kaizer F, Archambault P, Fung J. A novel approach to integrate VR exer-games for stroke rehabilitation: Evaluating the implementation of a 'games room'2017.
4. Fu MJ, Knutson JS, Chae J. Stroke Rehabilitation Using Virtual Environments. *Phys Med Rehabil Clin N Am*. 2015;26(4):747-57.
5. Lohse KR, Hilderman CG, Cheung KL, Tatla S, Van der Loos HF. Virtual reality therapy for adults post-stroke: a systematic review and meta-analysis exploring virtual environments and commercial games in therapy. *PLoS One*. 2014;9(3):e93318.
6. Ng YS, Chew E, Samuel GS, Tan YL, Kong KH. *Advances in rehabilitation medicine*. Singapore Med J. 2013;54(10):538-51.
7. Chen Y, Fanchiang HD, Howard A. Effectiveness of Virtual Reality in Children With Cerebral Palsy: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Physical therapy*. 2018;98(1):63-77.
8. Garrett B, Taverner T, Masinde W, Gromala D, Shaw C, Negraeff M. A rapid evidence assessment of immersive virtual reality as an adjunct therapy in acute pain management in clinical practice. *Clin J Pain*. 2014;30(12):1089-98.
9. von Bernhardt R, Bernhardt LE, Eugén J. What Is Neural Plasticity? *Adv Exp Med Biol*. 2017;1015:1-15.
10. Cramer SC, Sur M, Dobkin BH, O'Brien C, Sanger TD, Trojanowski JQ, et al. Harnessing neuroplasticity for clinical applications. *Brain*. 2011;134(Pt 6):1591-609.
11. Johansen-Berg H, Dawes H, Guy C, Smith SM, Wade DT, Matthews PM. Correlation between motor improvements and altered fMRI activity after rehabilitative therapy. *Brain*. 2002;125(Pt 12):2731-42.
12. Calautti C, Baron JC. Functional neuroimaging studies of motor recovery after stroke in adults: a review. *Stroke*. 2003;34(6):1553-66.
13. Nudo RJ, Milliken GW. Reorganization of movement representations in primary motor cortex following focal ischemic infarcts in adult squirrel monkeys. *J Neurophysiol*. 1996;75(5):2144-9.
14. Lang CE, MacDonald JR, Gnip C. Counting repetitions: an observational study of outpatient therapy for people with hemiparesis post-stroke. *J Neurol Phys Ther*. 2007;31(1):3-10.
15. Saposnik G, Levin M. Virtual reality in stroke rehabilitation: a meta-analysis and implications for clinicians. *Stroke*. 2011;42(5):1380-6.
16. Laver KE, George S, Thomas S, Deutsch JE, Crotty M. Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev*. 2011(9):Cd008349.

17. Merians AS, Fluet GG, Qiu Q, Saleh S, Lafond I, Davidow A, et al. Robotically facilitated virtual rehabilitation of arm transport integrated with finger movement in persons with hemiparesis. *J Neuroeng Rehabil.* 2011;8:27.
18. Chen L, Lo WL, Mao YR, Ding MH, Lin Q, Li H, et al. Effect of Virtual Reality on Postural and Balance Control in Patients with Stroke: A Systematic Literature Review. *Biomed Res Int.* 2016;2016:7309272.
19. Wulf G, Landers M, Lewthwaite R, Töllner T. External focus instructions reduce postural instability in individuals with Parkinson disease. *Phys Ther.* 2009;89(2):162-8.
20. Glover S, Castiello U. Recovering Space in Unilateral Neglect: A Neurological Dissociation Revealed by Virtual Reality. *Journal of Cognitive Neuroscience.* 2006;18(5):833-43.
21. Adamovich S, Fluet G, Merians A, Mathai A, Qiu Q. Incorporating Haptic Effects Into Three-Dimensional Virtual Environments to Train the Hemiparetic Upper Extremity. *IEEE transactions on neural systems and rehabilitation engineering : a publication of the IEEE Engineering in Medicine and Biology Society.* 2009;17:512-20.
22. Bredesen DE, Rao RV, Mehlen P. Cell death in the nervous system. *Nature.* 2006;443(7113):796-802.
23. Frenkel-Toledo S, Giladi N, Peretz C, Herman T, Gruendinger L, Hausdorff JM. Effect of gait speed on gait rhythmicity in Parkinson's disease: variability of stride time and swing time respond differently. *Journal of neuroengineering and rehabilitation.* 2005;2:23-.
24. Mahoney JE. Why multifactorial fall-prevention interventions may not work: Comment on "Multifactorial intervention to reduce falls in older people at high risk of recurrent falls". *Arch Intern Med.* 2010;170(13):1117-9.
25. de Bruin ED, Schoene D, Pichierri G, Smith ST. Use of virtual reality technique for the training of motor control in the elderly. Some theoretical considerations. *Z Gerontol Geriatr.* 2010;43(4):229-34.
26. Radford K, Lincoln N, Lennox G. The effects of cognitive abilities on driving in people with Parkinson's disease. *Disabil Rehabil.* 2004;26(2):65-70.
27. Dockx K, Bekkers EM, Van den Bergh V, Ginis P, Rochester L, Hausdorff JM, et al. Virtual reality for rehabilitation in Parkinson's disease. *Cochrane Database Syst Rev.* 2016;12(12):Cd010760.
28. Baram Y, Miller A. Virtual reality cues for improvement of gait in patients with multiple sclerosis. *Neurology.* 2006;66(2):178-81.
29. Maggio MG, Russo M, Cuzzola MF, Destro M, La Rosa G, Molonia F, et al. Virtual reality in multiple sclerosis rehabilitation: A review on cognitive and motor outcomes. *J Clin Neurosci.* 2019;65:106-11.
30. Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. *J Speech Lang Hear Res.* 2008;51(1):S225-39.
31. Adamovich SV, August K, Merians A, Tunik E. A virtual reality-based system integrated with fmri to study neural mechanisms of action observation-execution: a proof of concept study. *Restor Neurol Neurosci.* 2009;27(3):209-23.
32. Rizzo A, Kim G. A SWOT Analysis of the Field of Virtual Rehabilitation and Therapy. *Presence.* 2005;14:119-46.
33. Deutsch JE, Brettler A, Smith C, Welsh J, John R, Guarrera-Bowlby P, et al. Nintendo wii sports and wii fit game analysis, validation, and application to stroke rehabilitation. *Top Stroke Rehabil.* 2011;18(6):701-19.
34. Gordon A, Okita S. Augmenting pediatric constraint-induced movement therapy and bimanual training with video gaming technology. *Technology and Disability.* 2010;22:179-91.
35. Perez-Marcos D. Virtual reality experiences, embodiment, videogames and their dimensions in neurorehabilitation. *Journal of neuroengineering and rehabilitation.* 2018;15(1):113-.
36. Weiss PL, Tirosh E, Fehlings D. Role of Virtual Reality for Cerebral Palsy Management. *Journal of Child Neurology.* 2014;29(8):1119-24.

37. Schuler T, Brüttsch K, Müller R, van Hedel HJ, Meyer-Heim A. Virtual realities as motivational tools for robotic assisted gait training in children: A surface electromyography study. *NeuroRehabilitation*. 2011;28(4):401-11.
38. Dietz V, Ward NS. *Oxford Textbook of Neurorehabilitation*: Oxford University Press; 2020.
39. Ravi DK, Kumar N, Singhi P. Effectiveness of virtual reality rehabilitation for children and adolescents with cerebral palsy: an updated evidence-based systematic review. *Physiotherapy*. 2017;103(3):245-58.
40. Ghai S, Ghai I. Virtual Reality Enhances Gait in Cerebral Palsy: A Training Dose-Response Meta-Analysis. *Front Neurol*. 2019;10:236.